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XCI. *Letters of the Abbé Mazeas, F. R. S. to the Rev. Stephen Hales, D. D., F. R. S. concerning the Success of the late Experiments in France. Translated from the French by James Parsons, M. D. F. R. S.*

S I R, St. Germain, May 20, 1752, N.S.

Read May 28, 1752. **T**HE favour done me by the Royal Society obliging me to interest myself in whatsoever concerns their honour, I beg you will communicate the following account.

The Philadelphian experiments, that Mr. Collinson, a member of the Royal Society, was so kind as to communicate to the public, having been universally admired in France, the King desired to see them performed. Wherefore the Duke D'Ayen offer'd his Majesty his country-house at St. Germain, where M. de Lor, master of experimental philosophy, should put those of Philadelphia in execution. His Majesty saw them with great satisfaction, and greatly applauded Messieurs Franklin and Collinson. These applausees of his Majesty having excited in Messieurs de Buffon, D'Alibard, and De Lor, a desire of verifying the conjectures of Mr. Franklin, upon the analogy of thunder and electricity, they prepar'd themselves for making the experiments.

M. D'Alibard chose, for this purpose, a garden situated at Marly, where he placed upon an electrical body a pointed bar of iron, of 40 feet high. On the 10 of May, 20 minutes past 2 afternoon, a stormy cloud

cloud having pass'd over the place where the bar stood, those, that were appointed to observe it, drew near, and attracted from it sparks of fire, perceiving the same kind of commotions as in the common electrical experiments.

M. de Lor, sensible of the good success of this experiment, resolved to repeat it at his house in the Estrapade at Paris. He rais'd a bar of iron 99 feet high, placed upon a cake of resin, two feet square, and 3 inches thick. On the 18 of May, between 4 and 5 in the afternoon, a stormy cloud having pass'd over the bar, where it remain'd half an hour, he drew sparks from the bar. These sparks were like those of a gun, when, in the electrical experiments, the globe is only rubb'd by the cushion, and they produced the same noise, the same fire, and the same crackling. They drew the strongest sparks at the distance of 9 lines, while the rain, mingled with a little hail, fell from the cloud, without either thunder or lightning ; this cloud being, according to all appearance, only the consequence of a storm, which happen'd elsewhere.

From this experiment we conjectur'd, that a bar of iron, placed in a high situation upon an electrical body, might attract the storm, and deprive the cloud of all its thunder. I do not doubt but the Royal Society has directed some of its members to pursue these experiments, and to push this analogy yet further.

I do not know, Sir, whether Mr. Franklin's letters were before your considerations upon earthquakes : if they were, we are oblig'd to Mr. Collinson for his communication of Mr. Franklin's notions ; if they are not, you deserve the honour of the discovery ; and whosever

soever it be, it is still to the Royal Society we owe the communication of this ingenious thought, which the experiments of M. D'Alibard and M. De Lor have confirm'd. These two learned men deserve that esteem of our nation, which their talents have a long time procured them. I am, with a profound respect,

S I R,

Your most humble, and
obedient servant,

G. Mazeas.

S I R, St. Germain's, June 14, 1752.

Read Nov. 23, 1752. **M**ONSIEUR D'Alibard, the translator of Mr. Franklin's treatise relating to electricity, acknowleges, that the ingenious discovery of the analogy between thunder and electrical matter is due to you. Since you were the first *, who gave us a clear idea of it, I ought to not be wanting to give you an account of the advances, which this discovery has made in this country.

On

* In this the Abbé Mazeas has not been sufficiently well informed, as, for several years, this analogy has been deduced by several gentlemen of the Royal Society, who were engaged in these pursuits. Even the late Mr. Stephen Gray, so early as the year 1735, takes notice of it, and says, " that this electric fire, by several of these experiments, seems to be of the same nature with that of thunder and lightning." See *Phil. Trans.* N. 436.

On the 7 of June, a violent storm happening at Paris, and about it, the greater part of the philosophers endeavour'd to repeat the experiment, which I had the honour to mention in my last letter. I was assured, that no one succeeded at Paris; some looking upon the experiment as false, while others attributed their want of success to the abundance of rain, that wet the cakes of resin, which they used to support the bar of iron.

M. Le Monnier, having prepared to repeat the same experiment here, in the presence of the Duke D'Ayen, avoided that inconvenicnce in the resin cakes. He placed, in the garden of the *hôtel de Noailles*, a wooden pole, of about 30 feet high, at the end of which was fix'd a large glass tube, which receiv'd at the other end a long tin pipe; and this pipe receiv'd again, in its turn, a pointed bar of iron, of about 6 feet high. The glass tube, as you see, was instead of the cake of resin, to hinder the communication of the electricity from the tin pipe to the pole. A wire was carried from the bar of iron, which rested upon a silken cord, about 50 paces from the pole; but rain coming on, the wire was conducted into the house. We perceived the commotions of the electrical matter from the first clap of thunder; it produced sparks, and there were certain intervals, wherein the commotions were so strong, that they were accompanied with very sharp pain: and I am persuaded, that, if the tin-pipe had triple or quadruple more surface, no one could touch the bar of iron, without paying dearly for it. It seem'd to me, as if the commotion was the greater, the nearer the thunder was to the bar. This is the experiment, that was executed

Y y y here,

here, which I was a witness to. The fear, that seiz'd several ladies, who were present, hinder'd its continuation ; and we were even obliged to take away the bar, and the whole apparatus.

After this experiment, I propos'd satisfying myself concerning a notion I conceiv'd, and which the weather suffer'd me to execute but imperfectly. The nature of the vapours, which compose thunder, is not absolutely unknown to us. Would not the mixture of salts, sulphur, pyrites, &c. produce vapours capable of electrifying a bar of iron ? By suspending a bar of iron upon filken cords, and causing a wire to descend into a large glass recipient, wherein pyrites and other analogous matters, as sea-salt with oil of vitriol, may be made to ferment, in order to produce a vapour, which would contain spirit of salt, or which might develope the electrical matter ; might not we come to produce the same phænomenon with that produced in a storm ? Upon this footing I tried some experiments, which my busines hinder'd me from pursuing ; but the success did not perfectly answer my expectation. I thought I perceiv'd some signs of electricity ; but they were so doubtful, that I do not mention them. If I make any future attempts of this kind, I shall have the honour of communicating them. I am, with the most respectful attachment,

S I R,

Your most humble and

most obedient servant,

Guill. Mazeas.
S I R,

S I R, St. Germain, June 29, 1752.

Read Nov. 23,

1752.

ON the 26 of this month we had a storm at two different times: the first was at 3 in the afternoon, and the second at half an hour after 6. This storm, which came from the south-west, was very inconsiderable: there were but two or three claps of thunder, either at 3 or at 6 o'clock; and there was a considerable interval between the lightning and the clap, which shew'd, that the thunder was at a great distance. Nevertheless the effects of the electricity were very violent, which I attribute to M. Le Monnier's ingenious apparatus; which is as follows:

It is certain, by M. Muschenbroek's experiments, that the more surface the electrified bars have, the commotions are the more violent; but, as it would be difficult to fasten rods or bars of a certain size to the ends of the great wooden poles, M. Le Monnier has ingeniously supplied that defect, in forming a magazine for the electricity. This magazine is only a communication of the electricity, which descends from the bar of iron, situated at the top of the pole, with several other large bars of iron placed near the pole.

The greater the quantity of these bars, the greater is the quantity of electricity furnish'd by the magazine.

In the last experiment we had a tin pipe, of 7 feet long, and about 5 inches diameter. It was the first magazine: the second consisted of six great bars of iron of six feet long each, placed in parallel order upon glass bottles. All these magazines communicated with the iron wire, that descended from the little bar at the top of the great pole, which I described in my last letter.

The 26 of this month, at 3 afternoon, very lively sparks were excited, and M. Le Monnier set fire to spirits of wine. At 6 o' clock I went up to a proper place, in order strictly to observe the intervals between the commotions and the electricity.

The clouds extended from the south and west to the zenith of the pole, and the lightning came from a very distant part ; and, in proportion as the clouds came nearer, the electricity was felt with very smart shocks, but without light, or regularity ; for sometimes none were felt for two or three minutes ; and it was commonly with every flash of lightning that the commotion was felt. But when the clouds had cover'd a considerable part of the heavens, the commotions of the electricity succeeded very quickly with noise and sparks ; altho' the thunder could scarce be heard, because of its distance. It may from hence be judged, how strong the commotions would be, if the clouds, which produced the thunder, were nearer the bar.

On the 29 of June we had another storm ; but I was not present at the experiments made in the garden, being myself employ'd in a like experiment in my chamber. I placed at my window, which was about 35 feet from the ground, a bar of iron of 12 feet long, which receiv'd a very sharp iron wire of six feet high ; the whole advanced into the street, by means of a wooden pole laid parallel to the horizon ; at the end of which was a glass tube fill'd with resin, in order to receive the iron rod. The wire, that hung from the extremity of the pole, enter'd into my chamber, and from thence into a gallery of 30 feet long. The electrical magazine was in my chamber,

chamber, and the iron wire, after several turnings, was again brought thither. I had disposed of this wire in such a manner, that, if the storm should come in the night, or if it happen'd by day, I had it in my power to observe all I proposed, without quitting my bed on the one hand, or leaving my business on the other.

The storm came at 5 in the evening; and although I had not yet time enough to form a sufficient magazine of electricity, I had nevertheless very satisfactory signs. The person, who held the iron wire, felt a commotion; and, at the same instant, silken ribands were attracted by the electrical magazine. There came on a great shower of rain and hail, which wetted the resin in the glass tube, that supported my bar; and after that I had no more signs of electricity.

The same thing happen'd in the garden; where the silken cords, which, in several places, interrupted the communication of the electrified bodies with the non-electrics, having been wet, sensibly diminished the desired effect. The electricity, however, was very strong before the rain fell; and the commotions were felt at about a foot distance: but the storm only passed by, and lasted no more in the whole than two or three minutes.

Hence, Sir, it follows, that the electrical magazine is an important object in experiments of this kind. I do not even doubt, but that, by placing guns and bars of iron, in great numbers, in places adjacent to the wooden pole, we might even come to kill animals, and verify all the surprising phænomena, that thunder has produced for so many ages.

This

This may be done without going out of one's room, and even in bed, where one might easily be assured of the degree of the force of a storm, by the degree of the strength of the commotions: and if we were loth to touch the iron wire with a finger, for fear of the pain, we might use a little plate or blade of tin, fastened to the end of a glass tube. One might, by this means, have the satisfaction of judging of the degree of the strength of thunder.

I forgot to observe, that my iron bar was too near the neighbouring houses, which greatly lessen'd the electrical power.

I beg, Sir, you will, in my name, assure the Royal Society of the sentiments of respect and acknowledgement, which I owe it, for the honour it has done me. I also repeat them to you, Sir, and to Messieurs Wilson, Pringle, and Knight; and am,

S I R, &c.

Guill. Mazeas.

S I R, St. Germain, July 12, 1752.

Read Nov. 23, 1752. **O**N the first, second, and tenth of July, we had storms at St. Germain; of which I have the honour to give you an account.

I was not a witness to the experiments, that were made on the first and second of this month in the garden of the Hotel de Noailles; because I was then busy in my chamber; which I shail mention by-and-by: but the following is what was told me, and

and since confirm'd, by Mr. Le Monnier, who perform'd them himself.

1. He was convinced, that the high situation, in which the bar of iron was commonly placed, is not absolutely necessary to produce the effects of electricity: for a tin speaking trumpet suspended upon silken cords about five or six feet from the ground, has produced very particular signs of electricity.

2. A man, placed upon a cake of resin, and holding with his hand a wooden pole, of about 18 feet long, round which an iron wire was twisted, was so well electrified, while it thunder'd, that sparks, which were very lively, were drawn from his face and hands.

3. Having taken away the communication of the electrical magazine with the iron wire, which hung from the great wooden pole (this magazine consisted, as I have said in my last letter, of 6 great bars of iron, placed horizontally upon glass bottles, about 4 feet from the ground) I say, this magazine was strongly electrified, when the stormy cloud passed in the zenith.

4. A man, standing upon the electrical cake in the middle of the garden, and simply holding up one of his hands in the air, attracted with the other hand wood-shavings, which were held to him upon a piece of lead. Whence it evidently follows, that the matter, which is the cause of all the surprising phænomena, which electricity affords us, fills the atmosphere in the time of a storm.; that it penetrates us; that we breathe it with the air; and that the height usually given to the iron bar only serves to intercept the far greater quantity of the electrical matter.

At the time that Mr. Le Monnier made his experiments, I, in my turn, tried to perfect the manner of bringing the electricity into my chamber. This method seem'd to me the more essential, as the glass tubes, which Mr. Le Monnier substituted to the electrical cakes have not the advantage of keeping the electricity in the iron bar, when a good deal of rain falls. When these tubes are too wet, the electricity ceaseth.

I therefore increased the length of my wooden pole, which went out of my window, and, at the same time, that of my iron rod, which was perpendicularly fastened to its end. The greater the length and height of these two were, the stronger was the electricity in my chamber; which led me to the two following observations:

1. My chamber having two windows opposite to each other, the one to the south, looking into a street, and over-against the neighbouring houses; the other to the north, with an unbounded prospect of the country; I found the electricity was stronger, when my pole was supported by the resin cake placed upon the north window, than in the other opposite to the houses; which made me imagine, that the electrical matter was more strongly attracted by the neighbouring large buildings than by my pole.

2. I observed a considerable diminution of the electricity when rain came on, altho' the thunder roar'd very strongly, and the cake of resin on my window was not wet: which made me think the rain, as it fell, might deprive the atmosphere of the electrical matter, when it is in a sufficient quantity to carry away with it a large portion of that matter.

Here

Here is a fact, which establishes that opinion: when the rain ceased for some time, my pole, altho' wet, produced new signs of electricity.

Hitherto the electricity appear'd to me to be stronger in the beginning, than in the middle or end of a storm; that is, in proportion as it approach'd, till it was immediately over the pole.

I draw this fact from the observations, which I made from the first and second of July, without giving it as a general one: however, I now reassume the experiment of the 20 of the same month.

Towards 11 in the morning, the heavens began to be cover'd to the south-west, with some claps of thunder and lightning at a great distance. I had just time to go to the garden, where I found the Duke d'Ayen, who had prepared every thing for the experiments. An iron wire descended from the top of the pole, and rested upon the hot-house of the garden: this wire was supported by a silken cord, and was terminated by a tin cylinder, of about 3 inches diameter, and 3 feet long. The electricity of this cylinder was such, that, when a finger approach'd it, two or three very lively sparks at a time were produced, with a sparkling noise, like that of the nails of one's fingers crackled against each other.

Then the Duke d'Ayen took the first shrub he met in the hot-house, which happened to be that, from which the *labdanum* is produced, as well as I can remember: he placed it with its pot on a cake of resin, and fastened the iron wire to one of its branches. This shrub was instantly electrified; so that whitish sparks issued from every leaf, with the same kind of crackling I have just mention'd; but

the trunk of this shrub had a much stronger electricity; whether, at that instant, the electricity of the cloud was more strong, (for it varies every moment) or that the force of the whole electricity, expanded thro' the leaves, became concentrated in the trunk of this shrub *.

The Duke then took one of his silver watering-pots, which was two feet and an half high; he fill'd it with water within an inch of the brim, and placed it upon the electrical cake, dipping into it a wire of lead, which communicated with that wire, which came from the top of the pole. Of all the electricity tried till then, this was incomparably the strongest: nor did I see any sparks, when I advanced my finger towards it, but the shock affected me in the arms and breast with such violence, that I did not attempt to make a second trial. Wherefore it would be well, before one runs the hazard of such sort of experiments, to try the force of the electricity, by applying an iron wire, or a piece of steel, fastened to a little glass tube. During these experiments M. le Monnier was absent; which deprived us of some new designs, which he had resolv'd to put in practice.

I am, Sir, &c.

G. Mazeas.

* This experiment was made the 2 of July by M. le Monnier, and repeated, as I have now mention'd it, on the 11 of the same month.

S I R,

Paris, Aug. 21, 1752.

Read Nov. 23, 1752. **A** Phænomenon, which I have always thought worthy of strict observation, is the diminution of the electricity of thunder, when rain comes on during the storm. This diminution was remarked at St. Germain, every time I was a witness to M. le Monnier's experiments; and the same effect is, within this little while, confirm'd to me by the learned Mr. Euler, in communicating to me the observations of M. Ludolf. I have thought of only three causes assignable to this phænomenon, which I lay down in the following order:

1. Does not this diminution happen, because the drops of water, that run down the little bar of iron, carry with them the electricity of the bar?
2. Does not the rain, in passing thro' the atmosphere, deprive or strip it of the electricity, which is communicated to it by the thunder?
3. Or else, is it not more likely, that the diminution, and the total cessation, of the electrical streams happen then, either because the matter of the thunder is exhausted, or because the clouds coming to dissolve, the electrical matter is lost and dissipated?

I left St. Germain the 12 of July to come to Paris, at 7 in the evening. At the instant of my arrival, I saw the heavens cover'd with clouds, and the lightning foreboded thunder, which was soon heard. I went up into the gallery of the Hôtel de Noailles, which is very high, and distant from the neighbouring buildings: my pole was 10 feet high; at the end of which a glass tube was made fast; and to this a very sharp iron spire, from the middle of which a

wire of about 20 feet long came down, and rested upon a long glass tube, fixed to the balustrade which environ'd the gallery. My apparatus was scarce ready, when it thunder'd, and the clouds broke by this first clap, and pour'd down a continual large quantity of rain, which lasted near 2 hours, without the least discontinuance of the thunder.

I felt no commotion, in putting my finger towards the wire ; nor could I draw any sparks from it. I was upon the point of giving it over, when the wire happen'd to touch the leads and the balustrade of the gallery ; and it instantly produced as many sparks, as it touch'd places on the balustrade and leads. I then took the wire in my hand, and threw it strongly against the bars of iron ; and as the wire extended, and successively touch'd the bars, it always produced the same effect. There were prodigious multitudes of these shining sparks, like those produced by the finger in common experiments. I only wanted an electrical magazine to accumulate electrical matter in, which would have produced me all the usual phænomena. The thunder was in its greatest vigour from half an hour after 8 to half an hour after 9 ; during which the rain was most abundant, and I repeated my experiment at several times.

It is therefore certain, 1. That the electricity sometimes ceases when it rains, but not always ; because, in the present case, the wire was as much impregnated with the electrical streams as it could be.

2. That the first and second question proposed above do not include the true cause of the cessation of the electricity at the time of rain ; since there are few storms, in which the rain is more abundant than

than this which fell the 12 of July in the evening, and wherein my apparatus was as wet as it could be.

3. It is again certain, by Mr. Ludolf's third experiment, mention'd hereafter, that this cessation does not happen, because the matter of the thunder is extinct. " When the rain was abundant (says he) we " remark'd nothing of this force of electricity, altho' " the lightning and the claps of thunder were ex- " ceeding strong."

The true cause of these kind of diminutions may therefore depend on some other principles, which we have not as yet come to the knowledge of. Hitherto this phænomenon presents us with a great many variations. I have seen circumstances, wherein simple clouds, without thunder or lightning, produced more electricity than when there was loud thunder: I have seen others, wherein the electricity did not shew itself but where there was lightning; and, in short, others, when the electricity, which seem'd dissipated during the rain, began again as soon as the rain ceased, altho' the thunder was very distant. The few experiments, hitherto made, are not sufficient to pronounce any certain opinion upon, with so many variations.

The little success I have had in trying, whether strong explosions, or violent fermentations of salts, sulphurs, and several liquors, would not produce some signs of electricity, does not surprize me. The matter contained in clouds may be of a different nature. The atmosphere of the earth is a more powerful sublimator than those of our chemists; and our weak operations will never perfectly come up to those of nature.

It remains, Sir, that I communicate to you the observations, that Mr. Ludolf made at Berlin. I present you with them, as Mr. Euler was so kind to send them, which I have transcribed word for word.

" As I was not present (says this learned man) at the experiments made upon thunder, I will have the honour to transcribe for you the recital, that Mr. Ludolf communicated to me. The experiments were made the 19 and 26 of July, and the 1 and 2 of August ;" and it is observed,

1. That the sparks drawn from the wire were half an inch long ; and they caused so horrible a shock, that the intire body of the person, who attracted them, was shaken ; but the small sparks produced only a light sensation in the fingers.

2. It is also remark'd, that this electricity communicates itself to all bodies elsewhere, that are susceptible of it, provided they are placed upon electrical bodies, while they are made to communicate by a wire.

3. When there was plenty of rain, we scarce remarked any thing of the force of the electricity, altho' the lightning and claps of thunder were very strong.

4. At every clap of thunder the electricity seem'd extinct, and returned not till after 30 seconds, or thereabout, and sometimes longer.

5. When the wire was surrounded with drops of rain, it was observ'd, that only some of them were electrical, which was remarkable by the conic figure they had ; whilst the others remain'd round as before. It was also perceived, that the electrical and non-electrical drops succeeded almost alternately ; which

which made us call to mind a very singular phænomenon, which happen'd some years ago to five peasants, who pass'd thro' a corn-field, near Francfort upon the Oder, in a storm. The thunder kill'd the first, the third, and the fifth, without injuring the second and fourth.

6. The storm of the first of August was very considerable, with very great rain; every minute we remarked 3 or more flashes of lightning; in the mean time some electrical sparks were observ'd upon the wire. They put upon a chain, which communicated with the wire, a thread, the two ends of which hung down; which shew'd electricity, by mutually repelling each other; for, at every flash of lightning, they approached other suddenly, as if they had been push'd one against the other by some force.

7. Sometimes the electricity continued in the wire with great strength to 45 minutes, after the thunder and lightning had intirely ceased, &c.

Conformable to the 6 observation of Mr. Ludolf, I have often observed, that, in presenting dust or dry'd snuff to the end of a tin cylinder, which hung to the wire in these sort of experiments, this dust was strongly attracted, as soon as the wire shew'd any signs of electricity. But, when the electrical matter came to be accumulated in this cylinder, the dust was powerfully repell'd as by a strong blast, insomuch that the quantity of molecules repell'd was much greater than of those attracted at the same time.

And with respect to this successive attraction and repulsion, I must not pass by in silence an experiment I was

I was informed of, without knowing the author of it *. The dishes of a pair of scales were suspended to the balance by filken cords, the two dishes were electrified, and a very sharp needle was presented to one of them. The scales immediately lost their equilibrium ; and that dish, under which the needle was held, was attracted. The direct contrary happen'd, when an obtuse or round body, such as a leaden bullet, was put upon the point of the needle ; for then the dish was repell'd.

If this experiment be true, as I have all the reason in the world to believe it so, it strongly imitates what happens in the clouds, when they are *in æquilibrio* in the atmosphere : and it gives us room to conjecture, that it would be much less dangerous to terminate the tops of steeples with obtuse bodies, than with pointed spires, upon which the thunder falls sooner or later, when they are very high.

As the year begins to draw to an end, I believe these observations will be the last for the year 1752. an epocha, which will always be famous with the lovers of electricity ; and particularly myself, because it has given me an opportunity of testifying, from time to time, the respect I have for your person, and the acknowledgments I owe to that friendship, with which which you honour

Your most humble, &c,

G. Mazeas.

* Since I wrote to Dr. Hales, I found this experiment among those of Mr. Franklin.